

# An outbreak of organomercury poisoning among Iraqi farmers

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An outbreak of organomercury poisoning due to the consumption of treated grain by farmers and their families occurred in Iraq in 1971-72. A total of 6530 cases were admitted to hospital and of these 459 died. However, there were many more with minor symptoms of poisoning who consulted outpatient departments. This outbreak constituted the largest poisoning epidemic ever recorded. No age was exempt and no pronounced sex difference was apparent. The latent period of up to 60 days between dosage and the onset of symptoms was probably the major factor contributing to the size of the epidemic. Measures taken to limit the outbreak are outlined.

Between December 1971 and March 1972 a serious outbreak of poisoning occurred in Iraq, caused by an organic mercurial fungicide which contained methylmercury compounds as the active ingredient. This fungicide has been widely used for seed dressing. It prevents wheat bunt and other infectious diseases of crops, thereby greatly increasing the crop yield.<sup>1</sup> Methylmercury, along with the other short-chain alkylmercurial, ethylmercury, is more hazardous to man than other forms of mercury. It may cause severe, irreversible damage to the nervous system and, owing to its ability to cross the placenta, it can cause prenatal poisoning.<sup>2</sup>

Poisoning by short-chain alkylmercurial compounds may result from inhalation of the dust or vapour, as in occupational exposures during the seed-dressing process,<sup>1</sup> from absorption through the skin after topical application,<sup>3</sup> and from oral ingestion of contaminated food.

The vast majority of cases of poisoning from methylmercury and ethylmercury compounds have resulted from consumption of bread prepared from wheat or barley treated with a mercurial fungicide. The 1971-72 outbreak was preceded by two others in Iraq, in 1956 and 1960<sup>4</sup> and by outbreaks in Guatemala,<sup>5</sup> Pakistan<sup>6</sup> and, more recently, in Ghana.<sup>7</sup> Consequently, the Ministry of Health immediately recognized the need for a coordinated scientific study of this tragic outbreak, with complete publication of the findings so as to prevent further catastrophes in the future.

The previous outbreaks in Iraq were stated to have been caused by ethylmercury compounds (ethylmercury p-toluene sulfonanilide).<sup>4</sup> At first it was believed that the 1971-72 outbreak was also caused by ethylmercury p-toluene sulfonanilide,<sup>8</sup> but subsequent gas chromatographic analyses of samples of treated grain revealed that the mercurial fungicide contained predominantly methylmercury compounds.

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The story begins with the distribution of grain to farmers between 15 September, 1971 and the first week of December, 1971. Some 20 days later, on 26 December, the Ministry of Health was informed that cases of poisoning had been admitted to Kirkuk Hospital.

A total of approximately 73 000 metric tons of treated wheat and 22 000 metric tons of treated barley were distributed throughout the country. The northern provinces of Mosul, Kirkuk, and Erbil received approximately 70% of the total amount of grain (Table 1). Approximately equal amounts of grain, 10-14% of the total, were distributed to the central and southern provinces. The amount of treated wheat distributed to each area was approximately 3-4 times the amount of treated barley. The results of surveys of samples of wheat and barley reveal that all of the imported wheat was treated with methylmercury compounds. Most of the treated barley was also treated with methylmercury compounds, but a small fraction, less than 10%, was treated with phenylmercury compounds.

TABLE 1. DISTRIBUTION OF GRAIN AND HOSPITAL ADMISSIONS IN THE PRINCIPAL GEOGRAPHICAL AREAS OF IRAQ

	Area <sup>a</sup>				Total
	north	central	south	other	
Grain distributed					
% total: wheat	72	14	10	4	100
barley	68	14	14	4	100
Hospital admission cases (deaths)					
26 Dec. 1971 - 23 Feb. 1972	1 058(48)	2 472(110)	1 970(131)	57(2)	5 557(291)
% total admissions	16.2	37.9	30.2	0.8	85.1
24 Feb.-27 March 1972	71(31)	350(79)	138(47)	32(4)	591(161)
% total admissions	1.1	5.4	2.1	0.5	9.1
after 27 March 1972	107(-)	101(-)	142(6)	32(1)	382(7)
% total admissions	1.6	1.5	2.2	0.5	5.8
Total	1 236(79)	2 923(189)	2 250(184)	121(7)	6 530(459)
Percentage	18.9	44.8	34.5	1.8	100.0

<sup>a</sup> The provinces included in each area are as follows:

North: Mosul, Kirkuk, Arbil; central: Baghdad, Diyala, Wasit, Babylon, Kerbela; south: Gadisiya, Maysan, Thi-Qar, Muthanna, Basra; other: D'hok, Sulaimaniya, Anbar.

A limited amount of seed dressing may also have taken place within Iraq. It has been customary in the northern provinces to treat grain with a phenylmercury compound, and small amounts of ethylmercury may also have been used locally. However, neither phenylmercury nor ethylmercury compounds have been detected in samples of blood or hair collected from patients suffering from organomercury poisoning. Although such surveys have not been extensive it seems unlikely, in view of the generally common picture of clinical signs and symptoms throughout the country and the widespread distribution of the imported grain, that phenylmercury or ethylmercury compounds contributed significantly to this outbreak.

Details of hospital admissions and deaths in hospital of the patients poisoned by mercury are given in Table 1. The first hospital admissions were on 21 December, 1971 and few hospital admissions were reported after 27 March, 1972. The rate of admissions to hospitals throughout the country was very high in early January 1972, reaching several hundred cases per day. In late February, admissions had fallen to less than 5 per day. Approximately 90% of the cases were admitted during January and February, 1972.

Cases of methylmercury poisoning were admitted in hospitals throughout the country (Table 1). Up to 23 February, 1972, 5 557 patients had been admitted to hospital, of whom 291 died. The highest proportion of admissions (37.9% of the total number of cases) was noted in the central areas; the next highest was in the south. However, it should be noted that in this area, one province, Qadisiyah, accounted for over half the admissions. The mortality in hospital, expressed as a percentage of the admissions, did not vary greatly throughout the country, ranging from 3.5% to 6.6%.

Admissions to hospital from 24 February to 27 March, 1972 are also shown in Table 1. The total admissions were 591, and 161 deaths in hospital were recorded in this period. These figures indicate that the rate of admissions after the end of February decreased sharply. The geographical pattern was approximately the same as previously, with the largest number coming from the central areas, and the next largest from the south. However, the mortality in hospitalized patients, expressed as a percentage of admissions, was dramatically higher. The figures range from 23% in the central areas to as high as 44% in the north. These higher percentages undoubtedly reflect the fact that patients admitted in January and February were dying in March. It is probable that the actual mortality in these cases admitted to hospital will never be known, as many of them may have been discharged because the hospitals were full and new patients had to be admitted for treatment. One cannot discount the possibility, therefore, that patients discharged from hospital died afterwards.

After 27 March, 1972 admissions continued, totalling 382 patients but the 7 deaths indicated a much lower death rate. The regional proportion of admissions remained the same.

Thus, the grand total of admissions during the outbreak was 6 530. The number of deaths in hospital was 459, giving an overall death rate of 7.0%.

The figures for the distribution of grain to the main geographical areas, as shown in Table 1, clearly indicate that hospital admissions in various parts of the country did not correlate with the amount of grain distributed to those areas. The highest amounts of grain were distributed to the north, whereas the largest number of hospital admissions occurred in the central and southern areas of the country.

All cases of poisoning occurred among farmers and their families who consumed the contaminated grain, and no city dwellers were affected. The poisoning was due to the consumption of home-made bread prepared from the treated wheat.

TABLE 2. DISTRIBUTION OF CASES OF POISONING  
ADMITTED TO HOSPITAL ACCORDING TO AGE AND SEX

Age (years)	Number admitted		Admissions/10 000 rural population	
	M	F	M	F
0-1	8	2	1	<1
1-19	1 725	1 762	14	16
20-39	796	1 034	18	20
40-60	404	416	14	15
Over 60	211	172	14	12
TOTAL	3 144	3 386	14	16

No age group was exempt from methylmercury poisoning (Table 2). The highest number of cases occurred in the age group 1-19 years. The numbers admitted to hospital in the older age groups show a steady decline. The lowest number of patients admitted was in the 0-1-year age group. An important factor determining hospital admissions would appear to be the age distribution in the rural population. Thus, when hospital admissions for each age group are expressed per 10 000 of the rural population in the same age group, it may be seen that the rates of admission are approximately the same for the age groups 1-19, 20-39, 40-60, and above 60 years. The only age group for which the admission rate appears to be significantly less than the others is the 0-1-year group. The probable explanation for the low proportion of admissions of infants under 1 year of age is that these infants did not have access to the contaminated bread. Approximately half of them would have been born before the onset of the epidemic. Their chief, if not sole, source of methylmercury would have been their mothers' milk.

No pronounced differences between males and females were apparent in the number of admissions in the various age groups. This is not surprising, since the source of the mercury was probably home-made bread prepared by each family and it is likely that all members of the family were exposed to mercury.

The cases of poisoning indicated in Table 2 represent only the tip of the iceberg. These are the patients with moderate to severe signs and symptoms of poisoning who sought treatment at a hospital. There were many more patients who consumed smaller amounts of the contaminated grain and attended outpatient departments for advice on minor symptoms of headache and numbness of fingers and tongue. This iceberg effect is illustrated in Fig.1 where the blood mercury levels from a sample of a village population near Baghdad are shown. This figure illustrates the proportion of the population having blood mercury below a specified level. The whole sample had blood mercury levels below 500 ng/ml when they were examined in July and August 1972, approximately 6 months after the outbreak. People having

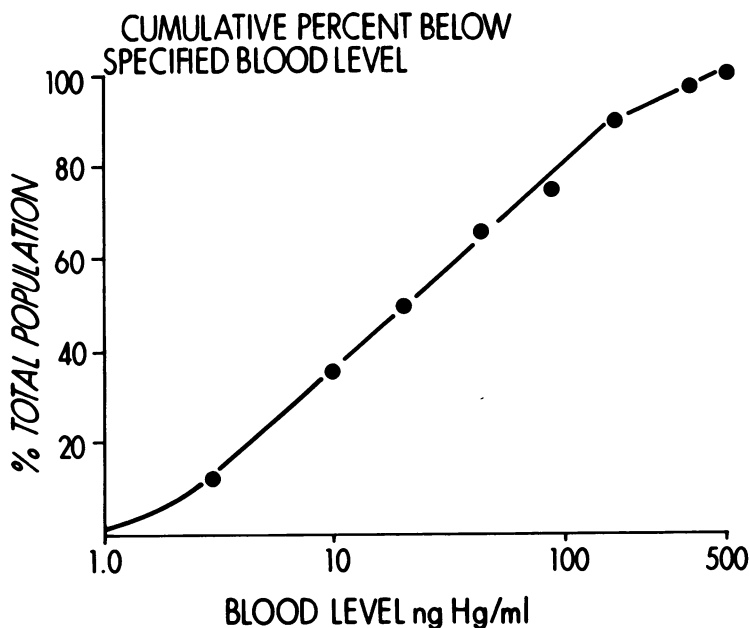


FIG. 1. CUMULATIVE PERCENTAGE OF PERSONS WITH A BLOOD MERCURY LEVEL BELOW A SPECIFIED VALUE IN A SAMPLE OF A VILLAGE POPULATION

blood mercury levels of the order of 500 ng/ml or above have a high probability of developing some signs and symptoms of methylmercury poisoning. However, one may see that in this population a large number of people were in the intermediate range, from the normal (1-10 ngHg/ml) up to 200-500 ngHg/ml. It is therefore apparent that the patients who were admitted to hospital represent only the uppermost part of the exposure range and that there were substantial numbers in the rural population who received a lower dose.

Interviews with patients admitted to the Medical City Hospital revealed that most of the patients had stopped eating the contaminated bread before signs and symptoms of poisoning appeared. This latent period ranged up to 60 days. The delay in the onset of ill effects is one of the most hazardous properties of methylmercury and was a major factor contributing to the size of this outbreak. For example, some patients who eventually died in hospital did not experience ill effects until days or weeks after they had stopped eating the bread.

A number of measures were taken during the outbreak to limit its effects. Immediate contact was made with the chief medical officers of the 16 provinces and they were given detailed information on the exposure and on the spread and nature of the outbreak. Thus the hospitals were prepared to receive large numbers of patients.

The veterinary services in the country were consulted and steps were taken to determine the mercury levels of the viscera of slaughtered animals. Temporary restrictions were placed on the movement of cattle and their transport from one province to another. Restrictions were placed on the sale of meat. In the heavily affected provinces, Muthanna, Qadisiya, Babylon, Kirkuk, Diyala, and Wasit, slaughter was prohibited for a period of 2 months in order to study the results of the investigations.

At the same time, city health departments were approached and advised to collect samples of different food items in the market for laboratory examination in order to determine their fitness for human consumption, particularly in the case of the grain used in bakeries.

Health education, using audiovisual aids, was organized in the community, particularly aimed at informing farmers of the dangerous consequences of consuming the treated grain or the meat of cattle, domestic fowls, and birds of all kinds that had access to the treated grain. The hunting and killing of all species of birds was prohibited.

The most effective measure was the collection of surplus treated grain from the farmers and its withdrawal to storehouses.

The avarice of some and the ignorance of others in this modern age of science and technology can lead to tragic human consequences. More and similar epidemics are bound to occur in the developing world unless and until the use of toxic fungicides is discontinued. Furthermore, other means of treating grain to render it undesirable for human consumption should be developed. The distribution of treated grain should be strictly supervised. More effective and widespread health education programmes on the use and the dangers of such toxic substances should be organized for the community well before distribution.

#### RESUME

#### UN EPISODE D'INTOXICATION PAR ORGANOMERCURIELS CHEZ DES PAYSANS IRAKIENS

Un épisode d'intoxication par des composés organomercuriels, dû à la consommation par des paysans et leur famille de semences traitées, s'est produit en Irak en 1971-1972. Au total, 6530 malades ont été hospitalisés et 459 d'entre eux ont succombé. D'autres malades, en beaucoup plus grand nombre, présentant des symptômes mineurs d'intoxication, se sont adressés aux consultations externes. C'est le plus important épisode d'intoxication qui ait jamais été rapporté. Aucun groupe d'âge n'a été épargné et l'on n'a pas observé de différence de fréquence entre les sexes. La période de latence - jusqu'à 60 jours entre l'ingestion des semences traitées et l'apparition des premiers symptômes - est probablement le principal facteur expliquant l'ampleur de l'épisode. Les mesures prises pour endiguer la flambée sont décrites.

#### REFERENCES

1. HUNTER, D. Diseases of occupations. London, Little, Brown & Co., 1969, p. 306
2. KURLAND, L. T. An appraisal of the epidemiology and toxicology of alkylmercury compounds. In: Miller, M. W. & Clarkson, T. W. ed. Mercury, mercurials and mercaptans. Springfield, IL, Thomas, 1973, p. 23
3. TSUDA, M. ET AL. Yokohama med. Bull., 14: 287 (1963)
4. JALALI, M. A. & ABBASI, A. H. Poisoning by ethylmercury toluene suphonanilide. Br. J. ind. Med., 18: 303-308 (1961)
5. ORDÓÑEZ, J. V. ET AL. Estudios epidemiológicos de una enfermedad considerada como encefalitis en la región de los altos de Guatemala. Bol. Of. Sanit. Panam., 60: 510 (1966)

6. HAQ, I. U. Br. med. J., 1: 1579 (1963)
7. DERBAN, L. K. Outbreak of food poisoning due to alkyl-mercury fungicide on Southern Ghana State Farm. Arch. environ. Health, 28: 49-52 (1974)
8. DAMLUJI, S. & AL-TIKRITI, S. Mercury poisoning from wheat. Br. med. J., 1: 804 (1972)